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PRINCIPLES OF
ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

BY

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In charge of Power Transmission courses
Massachusetts Institute of Technology

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PREFACE

This work is intended primarily to serve as a text-book for Senio Graduate students in Electrical Engineering, students who are al familiar with fundamental single-phase and polyphase circuit theory with the operating characteristics of the more important types of nating-current machinery. A familiarity with the use of co quantities in alternating-current calculations is presupposed.

The book has been in a state of development during several yea teaching the Principles of Electric Power Transmission to Senio Graduate Students of the Massachusetts Institute of Technology has been in use as a text in the form of mimeographed notes for four years. The main educational objective of these courses has and is the inculcation of the fundamental scientific principles inv in power transmission, and the methods whereby they are mad plicable to practical engineering problems; and the secondary obje is the imparting of the maximum practicable amount of inform concerning present-day practice in electric power transmissio means of the examples and problems which necessarily form a part of the work if the students are to gain a thorough mastery o fundamental principles. Description of apparatus and equipmen been reduced to a minimum consistent with the understanding o principles involved. A special effort has been made always to imp clear physical conception of each problem, and wherever a mathema derivation of considerable length is required, an attempt has us been made, both before and after the analysis, to present the phy picture independent of mathematical symbols.

For convenience in reference, the most important of the formulas tables have been collected in an Appendix. Numerous problem included to afford practice in the application of the principles, and necessary mathematical tables are appended.

In attempting to correlate the existing knowledge on the sub naturally many gaps were found. Some of these the author has able to fill; attention is called to phenomena of which our knowled as yet incomplete.

This work was first undertaken in 1922 at the suggestion of T. H. Dillon, now of Harvard University, but then Professor of Ele

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PREFACE

This work is intended primarily to serve as a text-book for Senior and Graduate students in Electrical Engineering, students who are already familiar with fundamental single-phase and polyphase circuit theory, and with the operating characteristics of the more important types of alternating-current machinery. A familiarity with the use of complex quantities in alternating-current calculations is presupposed.

The book has been in a state of development during several years of teaching the Principles of Electric Power Transmission to Senior and Graduate Students of the Massachusetts Institute of Technology, and has been in use as a text in the form of mimeographed notes for some four years. The main educational objective of these courses has been and is the inculcation of the fundamental scientific principles involved in power transmission, and the methods whereby they are made applicable to practical engineering problems; and the secondary objective is the imparting of the maximum practicable amount of information concerning present-day practice in electric power transmission by means of the examples and problems which necessarily form a large part of the work if the students are to gain a thorough mastery of the fundamental principles. Description of apparatus and equipment has been reduced to a minimum consistent with the understanding of the principles involved. A special effort has been made always to impart a clear physical conception of each problem, and wherever a mathematical derivation of considerable length is required, an attempt has usually been made, both before and after the analysis, to present the physical picture independent of mathematical symbols.

For convenience in reference, the most important of the formulas and tables have been collected in an Appendix. Numerous problems are included to afford practice in the application of the principles, and the necessary mathematical tables are appended.

In attempting to correlate the existing knowledge on the subject, naturally many gaps were found. Some of these the author has been able to fill; attention is called to phenomena of which our knowledge is as yet incomplete.

This work was first undertaken in 1922 at the suggestion of Col. T. H. Dillon, now of Harvard University, but then Professor of Electric Power Transmission at the Massachusetts Institute of Technology. Assisted by the author, he drew up an outline of the course, which has since been modified but slightly. Due to his new work at the Harvar School of Business Administration and to other outside interests, h decided to withdraw from active co-authorship, but his continue interest has been manifested by his constructive criticisms and sug gestions. The author wishes to express his sincere thanks for Col Dillon's aid and coöperation.

Thanks are due also to Prof. Dugald C. Jackson, Head of the Depart ment of Electrical Engineering, Massachusetts Institute of Technology for suggestions and criticisms, and to Prof. W. H. Timbie, of the Massachusetts Institute of Technology, for valuable suggestions, especially in regard to arrangement of the material. Mr. F. W. Peek of the General Electric Company has very kindly read the chapter on Corona, and has offered valuable suggestions and furnished additional data on this subject. Other engineers have coöperated by allowing the publication of results of their work, and the author desires to express here his appreciation. References to the original sources are given throughout the book.

It is expected that the book of answers to the problems will be ready in June, 1926.

PREFACE TO SECOND PRINTING

The principal changes in the Second Printing are the complete rewriting of the chapter dealing with "Mechanical Principles" of sag and stress analysis, so as to include an improved method of calculation which has been developed within the past two years; and second, the correction of the errors which were discovered in the First Edition.

L. F. W.